COMP 6721

Applied Artificial Intelligence Project Report

Implementation of Naïve Bayes Algorithm used for Email Classification

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Abbreviations:

TP – True Positive

FP – False Positive

TN – True Negative

FN – False Negative

- **Analysis**

An important validation factor in Machine Learning classification is the performance of a model, a good model must have a certain acceptable level of accuracy. Meanwhile, using accuracy for performance measure is not sufficient enough as it can sometimes be misleading, e.g. a model might be very bad in predicting a certain category but its accuracy can still be very high. For this reason, we computed other metrics like precision, recall and f-measure to show how robust the performance of our model is. Table 1 below shows the performance for classifying spam and ham using the Naïve Bayes algorithm we implemented from scratch. The accuracies for classifying spam and ham are 89% and 99% respectively, a precision of 100% for both categories, recall of 89% for spam, 99% for ham, f-measure of 94% and 99% respectively.

	Spam	Ham	Formula
Accuracy	0.89	0.99	A = (TP+TN) / (TP+FP+TN+FN)
Precision	1.0	1.0	P = TP / (TP+FP)
Recall	0.89	0.99	R = TP / (TP+FN)
F1-measure	0.94	0.99	F1-measure = 2PR / (P+R)

Table 1: Performance results for classification

After prediction, the expected labels were separated into the two categories (spam, ham) with their respective predicted labels. After the separation we compute the accuracy, precision, recall and f1-measure for each category. Table 2, 3 shows the confusion matrix for spam and ham respectively. For the spam category, the classifier was able to correctly predict 356 test samples as spam (true positive) and misclassified 44 as ham (false negative).

Predicted	Expected	
	Spam	**Ham**
Spam	356	0
Ham	44	0

Table 2: Confusion matrix for spam category

Predicted	Expected	
	Ham	**Spam**
Ham	394	0
Spam	6	0

Table 3: Confusion matrix for ham category

On the other hand, the classifier correctly predicted 394 test samples as ham but wrongly predicted 6 as spam.

Table 4 shows the joint confusion matrix for both categories with which we computed the model's overall accuracy, precision, recall and f1-measure to be 94%, 90%, 99%, and 94% respectively.

Predicted	Expected	
	Ham	**Spam**
Ham	394	44
Spam	6	356

Table 4: Joint confusion matrix for ham category

References

[1] Aisha, J. (2018, August 26). Unfolding Naïve Bayes from Scratch.

[2] Praveen, D. (2018, December 18). An Introduction to Bag of Words And How To Implement it in Python for NLP

[3] https://stackoverflow.com/questions/12995937/count-all-values-in-a-matrix-greater-than-a-value